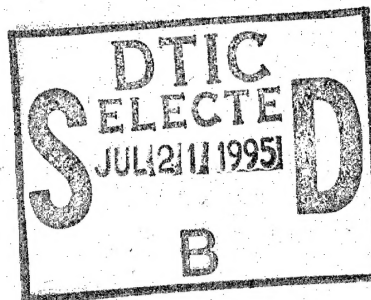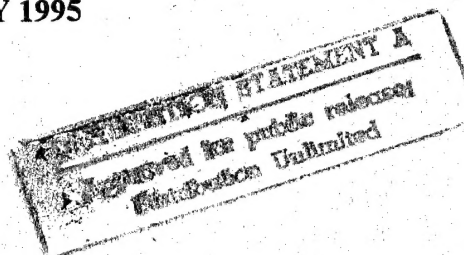DLA-95-P40139

ANALYSIS OF DELIVERY EVALUATION FACTOR APPLICATION

MAY 1995

FOR

DEPARTMENT OF DEFENSE
DEFENSE LOGISTICS AGENCY
Executive Director (Procurement)
CAMERON STATION
ALEXANDRIA, VA 22304-6100

INSIGHT THROUGH ANALYSIS

DORO

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IN REPLY
REFER TO

FOREWORD

During the last couple of years some Defense Logistics Agency (DLA) supply centers have developed procedures whereby competitive contracts are awarded to other than low bidders if awardees agree to provide earlier deliveries. Delivery Evaluation Factors (DEFs) are applied to convert reduced Production Lead Times (PLTs) to dollar values. These are used to adjust bid prices for evaluation purposes.

The Defense Industrial Supply Center has taken the lead in developing procedures for using DEFs. It has been using the system for small, competitive purchases for stock since February 1992. Recently it expanded the program to include large purchases. Somewhat similar programs have been introduced at the Defense Construction Supply Center and the Defense General Supply Center.

The three programs differ in many respects, including methods of determining evaluation adjustments for bids having different PLTs, resulting incentive payments to vendors, types of buys covered, and implementation procedures. Also concerns have been raised regarding the technical merits of using DEFs. DLA's Procurement Policy Group (AQPL) desired to have an objective analysis of the technical merits, costs, and benefits of the various DEF programs.

This report shows the effects that the program has had in terms of PLTs, unit prices paid to vendors, and late deliveries. Results for National Stock Numbers for which DEF buys were used are compared with results for similar NSNs with no DEF buys. The evaluation adjustment procedures used by different supply centers are compared. The validity of the various technical concerns is analyzed. Finally recommendations for improvements in the program are made.

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INSIGHT THROUGH ANALYSIS

EXECUTIVE SUMMARY

During the last couple of years three Defense Logistics Agency (DLA) supply centers have developed Delivery Evaluation Factor (DEF) procedures whereby competitive contracts are awarded to other than low bidders in return for early deliveries. The three programs differ in several major respects, including methods of calculating evaluation adjustments, types of buys covered, and implementation procedures. Concerns have been raised regarding both the overall value of the program and the relative merits of the individual programs at each center.

This study provides an analysis of the technical merits, costs, and benefits of the various DEF programs. Much of the analysis is based upon a review of the contract files for Defense Industrial Supply Center (DISC) for the period, January 1992 through June 1994. Experience with the DEF program at the other supply centers is too limited for meaningful analysis. The study also compares the evaluation adjustment procedures used by the various supply centers.

Average Production Lead Times (PLTs) declined during the period analyzed. The DEF program, as well as a number of other programs, probably contributed to this decline. DEF buys displayed especially large reductions in both average PLTs and percentages of late deliveries. Unfortunately, these reductions were not completely sustained in subsequent nonDEF buys. This is disturbing since the theoretical justification for paying incentives for lower PLTs depends upon their being sustained in subsequent nonDEF buys.

The analysis did not show that DEF buys cause increases in average unit prices. The method of determining evaluation adjustments used by the Defense Construction Supply Center (DCSC) has better theoretical justification and results in lower incentive payments than does the method used by the Defense General Supply Center and DISC. However, the DCSC method also has some limitations concerning the use of Federal Supply Class (FSC) aggregate factors for specific National Stock Number items. Item variability within a FSC could result in excessive or insufficient adjustments.

Insufficient information exists for making overall judgments about the extent to which DEF programs should be used. The answer depends upon considerations unique to each supply center, such as buyer and contractor awareness of the value of consistently low PLTs and use of other programs to maintain low PLTs.

When use of DEFs is appropriate, evaluation adjustments should be determined in accordance with a new proposed method. This method combines the theoretical base of the DCSC method with item unique data to more accurately estimate the value of reduced PLT.

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ABBREVIATIONS

CY	Calendar Year
DCSC	Defense Construction Supply Center
DEF	Delivery Evaluation Factor
DESC	Defense Electronics Supply Center
DGSC	Defense General Supply Center
DISC	Defense Industrial Supply Center
DLA	Defense Logistics Agency
DORO	DLA Operations Research Office
FSC	Federal Supply Class
FY	Fiscal Year
NSN	National Stock Number
PIIN	Procurement Instrument Identification Number
PLT	Production Lead Time

SECTION 1
INTRODUCTION

1.1   BACKGROUND

During the last couple of years some supply centers have developed procedures whereby competitive contracts are awarded to other than the low bidders if awardees agree to provide earlier deliveries. Delivery Evaluation Factors (DEFs) are applied to convert reduced Production Lead Times (PLTs) to dollar values. These are used to adjust bid prices for evaluation purposes.

The Defense Industrial Supply Center (DISC) has taken the lead in developing procedures for using DEFs. It has been using the system for small, competitive purchases for stock since February 1992. In June 1994, it expanded the system to include large purchases. The Defense Construction Supply Center (DCSC) has been using a somewhat similar program for large purchases since April 1994. Its program is limited to National Stock Numbers (NSNs) that have been determined to have artificially inflated PLTs. The Delivery Reduction Program, implemented at the Defense General Supply Center (DGSC) in March 1994, also is generally similar to the DISC program. It is used for stock buys over $10,000. The three programs differ in many respects, including methods of calculating evaluation adjustments, types of buys covered, and implementation procedures.

Several concerns have been raised regarding the technical merits of using DEFs. These include: (1) since unplanned early deliveries do not immediately reduce safety stocks, the assumed benefits may not be realized; (2) DEFs may need to be modified for very early deliveries because of diminishing marginal benefits; (3) early deliveries expected in DEF procurements may not be achieved; (4) although expected PLT reductions may be achieved in initial deliveries, they may not be sustained in subsequent deliveries, thereby voiding the expected benefits; and (5) the various methods of calculating DEFs may not be equally appropriate.

Beginning in 1987 the DLA Operations Research Office (DORO) has conducted a series of studies on costs of late contractor deliveries for supply centers. The most recent one is entitled, "Cost of Late Delivery for Post Award Consideration", DLA-94-P30116, May 1994. It was thought that some of the concepts and data developed in these studies may be useful in estimating the effects of early deliveries for use in developing DEFs.

1.2   OBJECTIVE

The overall objective of this study is to provide a sound analysis of the costs and benefits of the various DEF programs. Specifically, the objectives are: to evaluate the use of DEFs by supply centers to ascertain their effects on PLTs; and to analyze the technical merits of the use of DEFs and determine what improvements, if any, should be made.

1.3 <u>SCOPE</u>

The study addresses the use of DEFs at DCSC, the Defense Electronics Supply Center (DESC), DGSC, and DISC. Analyses of data in the contract files are confined to DISC for the period, January 1992 through June 1994. The other supply centers have had insufficient experience with the DEF program for meaningful analysis.

SECTION 2
METHODOLOGY

2.1 OVERVIEW

The results presented in this report are derived primarily from analysis of DEF policies and procedures as provided by personnel at headquarters DLA and the supply centers and by review of the contract files. These are discussed in subsections 2.3 and 2.4, respectively. In addition, concepts and data provided in the related earlier DORO reports mentioned in the Introduction were used.

It should be pointed out that DLA has a number of other programs which may also tend to reduce lead time. It is difficult to separate the effects of the DEF program from the other ongoing programs. These include:

- Automated Best Value Model (ABVM)
- Quality Vendor Program (QVP)
- Blue Chip Vendor Program (BCVP)
- Buy Response Vice Inventory (BRVI)
- Standard Automated Material Management System (SAMMS) Purchased by Electronic Data Exchange (SPEDE)
- Paperless Order Processing System (POPS)
- Commodity Oriented Purchasing System (COPS)
- Electronic Commerce
- Electronic Bid Board

The following subsection provides some technical definitions used throughout this report.

2.2 DEFINITIONS

2.2.1 EVALUATION ADJUSTMENT

The term, "evaluation adjustment", refers to the difference between total evaluated price after applying a DEF adjustment for delivery earlier or later than requested and total price as quoted. Other names include "evaluation factor adjustment" (DCSC), "$Adjustment" (DGSC), and "delivery evaluation factor" (DISC).

2.2.2 EVALUATION INCENTIVE

The term, "evaluation incentive", refers to the amount paid for a PLT reduction, provided that delivery is in accordance with the contract. It is the difference between the low bidder's total unevaluated price and the awardee's total unevaluated price. Other names include "price differential paid" (DCSC), "delivery reduction incentive" (DGSC), and "total evaluation differential" (DISC). Normally it is less than or equal to the evaluation adjustment.

2.2.3 DEF BUYS

DEF buys are purchases that involve payment of evaluation incentives. Buys which go through the DEF evaluation process but do not involve payment of evaluation incentives are not included. This occurs when application of evaluation incentives are not needed, (e.g. when a bidder offers both the lowest price and the shortest delivery) or when the differences in bids are greater than the DEF evaluation adjustments.

2.2.4 NONDEF BUYS

NonDEF buys are all purchases that are not DEF buys.

2.3 DEF POLICIES AND PROCEDURES

Documents referenced in this section are available upon request.

2.3.1 HEADQUARTERS DLA

Personnel at headquarters (AQP) provided background and general information on the DEF program both telephonically and during visits. Important guidance was provided at an In Process Review on 1 September 1994. In addition, methodology concerns were reviewed with MMS concerning the validity of savings associated with lead time reductions.

2.3.2 DCSC

Personnel at DCSC provided information on its program telephonically. Written materials also were provided. The key documents reviewed are the IOMs on "Delivery Evaluation Factor Test Procedures", dated 12 August 1993, and "DCSC Proposed Production Leadtimes (PLT) Evaluation Factor Clause and Provision", dated 22 April 1993.

2.3.3 DESC

Personnel at DESC provided information telephonically. DESC does not have a DEF program.

2.3.4 DGSC

A meeting with personnel at DGSC was held on 8 June 1994. Written materials also were provided. The key document reviewed is Policy Information Memorandum 94-8, dated 25 March 1994.

2.3.5 DISC

A meeting was held with personnel at DISC on 7 July 1994. Notes on this meeting were faxed to points of contact at each of the supply centers included in the study on 15 July 1994. Personnel at DISC also provided information and comments telephonically and in written materials. The key document reviewed is the memorandum on "Expanding the Use of the

Delivery Evaluation Factor (DEF) Program to Large Purchases (DPPT 94-4)", dated 21 April 1994.

2.4   CONTRACT FILES

2.4.1   GENERAL

Analyses of data in the contract files regarding the effectiveness of DEF buys were confined to DISC. Experience with DEF buys at the other supply centers is either nonexistent or so limited and recent as to be of little or no analytical value.

DEF buys are distinguished from nonDEF buys in the contract files by the Procurement Instrument Identification Numbers (PIINs). Purchase orders for DEF buys have "W" in the ninth position. Purchase orders for DEF buys awarded based on the Blue Chip Vendor Program, also known as the Quality Vendor Program, have "WB" in the ninth and tenth positions. Contracts for DEF buys have "CW" in the ninth and tenth positions.

Separate analyses were made of National Stock Numbers (NSNs) with DEF buys and comparable NSNs with no DEF buys. Both analyses cover the period, January 1992 through June 1994. The following statistics were calculated:

      1. Average PLT, defined as ship date less award date. Ship dates were used in lieu of receipt dates because they are more reliable. Receipt dates contained in the contract files often substantially lag actual receipts. Both arithmetic means and medians were computed.

      2. Average price per unit. Both arithmetic means and medians were computed.

      3. Percentage of buys that were delivered late. Late is defined as ship date later than contract delivery date.

For the purpose of determining the above statistics each buy was given equal weight (as opposed to weighting each NSN equally or weightings proportional to quantities or dollar values). Where averages were expressed both as medians and as arithmetic means, greater reliance was placed on the medians. This is because they are less influenced by abnormal outliers.

2.4.2   DEF BUYS

The analysis of NSNs with DEF buys covers only NSNs which had their first DEF buy in Calendar Year (CY) 1993 and which also had at least one nonDEF buy during the period of analysis. DEF buys after CY 93 were eliminated. This was done to determine the effects of DEF buys compared with preDEF buys and to determine whether any effects persist in subsequent nonDEF buys. The latter is of crucial importance because (according to inventory control theory) payment of evaluation incentives is justified only if PLT reductions persist in subsequent nonDEF buys. In order to reduce distortion associated with purchase quantities, all buys for an NSN that involved purchase quantities differing by more than a factor of five (i.e.

over 500 percent or less than 20 percent) of the average DEF buy for that NSN during CY 93 were eliminated. Statistics were calculated separately for preDEF buys, DEF buys, and postDEF buys.

2.4.3   NO DEF BUYS

The analysis of NSNs with no DEF buys covers only NSNs in Federal Supply Classes (FSCs) that had DEF buys during CY 93. This was done to provide reasonable comparability of NSNs included in the two analyses. In order to reduce distortion associated with purchase quantities, all buys for an NSN that involved purchase quantities differing by more than a factor of five from the average buy for that NSN during CY 93 were eliminated. Statistics were calculated separately for 1992, 1993, and 1994 (six months).

2.4.4   COMPARISONS

Although the two analyses are intended to represent NSNs differing only in the use of DEF buys, comparisons are not as clear as one would like. In particular, DEF buys are always competitive. Most nonDEF buys are not. Furthermore, if nonDEF buys are competitive, they usually go through the DEF evaluation process but are given to low bidders without the need to apply evaluation incentives.

2.4.5   SUPPLEMENTARY ANALYSES

Certain other analyses of the contract files also were made. The more important of these are:

1. A ten percent random sample was taken of all NSNs which had their first DEF buy in CY 93 and also nonDEF buys during the period of analysis. For each buy in each NSN the award date, contract PLT, actual PLT, type of buy, unit price, and purchase quantity was shown for the entire period of analysis. This analysis served a variety of purposes including help in designing the analyses described in previous paragraphs of this section.

2. An analysis of the distribution of cycle times for all NSNs at each of the four supply centers as of the second quarter of CY 94 was made. This helped in relating potential PLT reductions to procurement cycles, which were used in comparing alternative methods of determining evaluation adjustments.

SECTION 3
RESULTS

3.1   STATISTICS PROVIDED BY DISC

The results of the DORO analyses are shown in subsequent subsections. Relevant statistics provided by DISC are shown below. They were derived from the contract files for small purchases for Fiscal Year (FY) 1993 and FY 1994 through March.

Table 3-1
Statistics Provided by DISC

	FY 93	FY 94
Total number of awards	126,000	59,000
DEF buys as % of total awards	4.1%	5.7%
Average PLT, all buys (days)	199	204
Average PLT, DEF buys only (days)	89	105

Although the DEF program was generally used throughout the period, only a small portion of the buys involved payment of evaluation differentials. Average PLTs were much lower for DEF buys than for all buys.

The DISC analysis shown above should not be directly compared with the DORO analysis shown in the subsequent subsections. The methodology used in the two analyses are quite different. For example, the DISC analysis includes all NSNs, whereas the DORO analysis is limited to NSNs in FSCs which had initial DEF buys during CY 93. Also the measures of PLTs used in the two analyses are different. DISC used receipt date less award date. DORO used ship date less award date. The difference between ship date and receipt date includes not only transit time but also any delay at the receiving depot for processing and recording receipts.

3.2   NUMBER OF OBSERVATIONS

3.2.1   DEF BUYS

The DORO analysis of NSNs with DEF buys is based upon the following numbers of buys:

Table 3-2
Number of Observations: Analysis of NSNs with DEF Buys

	Number of Buys		
	PreDEF	DEF	PostDEF
NSNs with nonDEF buys before and after DEF buys.	1,195	805	861
NSNs with no nonDEF buys after DEF buys.	3,063	2,191	
NSNs with no nonDEF buys before DEF buys.		400	436

3.2.2 NO DEF BUYS

The analysis of comparable NSNs with no DEF buys is based upon the following numbers of buys:

Table 3-3
Number of Observations: Analysis of NSNs with No DEF Buys

	Number of Buys		
	1992	1993	1994
NSNs with buys in CY 92, 93, & 94.	4,184	4,937	2,844
NSNs with buys only in CY 92 & 93.	25,382	25,240	
NSNs with buys only in CY 93 & 94.		6,934	4,930

3.2.3 EVALUATION

The numbers of observations are sufficiently large to provide valid comparisons.

3.3 PLT COMPARISON

3.3.1 DEF BUYS

The average PLTs, in calendar days, of NSNs purchased using DEF buys are as follows:

Table 3-4
Average PLTs: NSNs with DEF Buys

		Production Lead Time (days)		
		PreDEF	DEF	PostDEF
NSNs with nonDEF buys	Median	95	54	68
before and after DEF buys.	Mean	111	66	81
NSNs with no nonDEF buys	Median	98	57	
after DEF buys.	Mean	118	69	
NSNs with no nonDEF buys	Median		54	73
before DEF buys.	Mean		71	88

3.3.2 NO DEF BUYS

The average PLTs of comparable NSNs not purchased using DEF buys are as follows:

Table 3-5
Average PLTs: NSNs with No DEF Buys

		Production Lead Time (days)		
		1992	1993	1994
NSNs with buys in	Median	61	53	43
CY 92, 93, & 94.	Mean	77	66	51
NSNs with buys only	Median	85	76	
in CY 92 & 93.	Mean	105	92	
NSNs with buys only	Median		59	43
in CY 93 & 94.	Mean		72	50

3.3.3 COMPARISON

Average PLTs declined during the period of analysis. The DEF program, as well as a number of other programs, probably contributed to this decline. Having a DEF program in place, tangibly demonstrates the importance management places on short PLTs.

DEF buys displayed especially large reductions in average PLTs. Unfortunately, the reductions were not completely sustained in subsequent nonDEF buys. Roughly one-third of the PLT reduction was not sustained (a "rebound" effect). Overall percentage declines in average PLTs were about the same regardless of whether any DEF buys had been used. Average PLTs were higher for nonDEF buys of NSNs with DEF buys than for NSNs with no DEF buys. This probably reflects a tendency to use DEFs for NSNs that display long PLTs.

3.4 UNIT PRICE COMPARISON

3.4.1 DEF BUYS

The average unit prices of NSNs purchased using DEF buys are as follows:

Table 3-6
Average Unit Prices: NSNs with DEF Buys

		Unit Price		
		PreDEF	DEF	PostDEF
NSNs with nonDEF buys	Median	$ 6.35	$5.41	$ 5.01
before and afterDEF buys.	Mean	48.54	48.53	44.90
NSNs with no nonDEF buys	Median	4.96	4.26	
after DEF buys.	Mean	32.50	30.80	
NSNs with no nonDEF buys	Median		4.32	4.45
before DEF buys.	Mean		31.56	33.15

3.4.2 NO DEF BUYS

The average unit prices of comparable NSNs not purchased using DEF buys are as follows:

Table 3-7

		Unit Price		
		1992	1993	1994
NSNs with buys in CY92, 93, & 94.	Median	$ 17.92	$ 19.26	$ 14.36
	Mean	130.05	149.19	121.68
NSNs with buys only in CY 92 & 93.	Median	11.60	10.92	
	Mean	105.01	97.54	
NSNs with buys only in CY 93& 94.	Median		15.51	11.70
	Mean		93.46	78.30

Average Unit Prices: NSNs with No DEF Buys

3.4.3 COMPARISON

Average unit prices declined slightly during the period of analysis. There is no indication that this is related to the DEF program. The analysis does not show that DEF buys cause increases in average unit prices.

3.5 LATE DELIVERY COMPARISON

3.5.1 DEF BUYS

The percentages of buys that were delivered late for NSNs purchased using DEF buys are as follows:

Table 3-8
Late Deliveries: NSNs with DEF Buys

	Late Deliveries (%)		
	PreDEF	DEF	PostDEF
NSNs with nonDEF buys before and after DEF buys.	28.5	15.4	26.7
NSNs with no nonDEF buys after DEF buys.	32.0	14.8	
NSNs with no nonDEF buys before DEF buys.		13.5	33.8

3.5.2 NO DEF BUYS

The percentages of buys that were delivered late for comparable NSNs not purchased using DEF buys were as follows:

Table 3-9
Late Deliveries: NSNs with No DEF Buys

	Late Deliveries (%)		
	1992	1993	1994
NSNs with buys in CY 92, 93, & 94.	18.7	16.8	12.0
NSNs with buys only in CY 92 & 93.	23.4	22.5	
NSNs with buys only in CY 93 & 94.		18.5	11.9

3.5.3 COMPARISON

The percentages of late deliveries were highest for nonDEF buys of NSNs which had some DEF buys. This suggests that DEF buys tended to be used for NSNs which had long PLTs and were more likely to be delivered late. Use of DEF buys substantially reduced late deliveries. Unfortunately, the improvements were not sustained in subsequent nonDEF buys.

3.6 EVALUATION ADJUSTMENTS

3.6.1 DCSC

The evaluation adjustments used at DCSC basically are the products of the following three terms:

1. Day Cost Ratio for applicable FSC. This is cost per day of lateness of additional inventory resulting from increased projected PLT triggered by late delivery, expressed as a decimal fraction of contract price. The cost of the additional inventory is the present value of the interest and storage costs required to carry the additional safety stock over the useful life of the item. The latest estimates of these costs are contained in the DORO report referenced in Section 1.1 of this report.

2. Number of days early (maximum of 30; negative numbers for days late).

3. Total contract price in dollars.

3.6.2   DGSC & DISC

The evaluation adjustments used by DGSC and DISC are essentially the same (although the procedures used for forecasting demand differ). They are the products of the following two terms:

    1. Average daily demand in dollars.

    2. Number of days early (negative numbers for days late).

3.6.3   COMPARISON

The two methods can be directly compared. The rationale is difficult to explain in simple sentences. It may be explained algebraically as follows:

Let:
        R = Day Cost Ratio
        E = Number of days early
        P = Total contract price in dollars
        D = Average daily demand in dollars
        C = Procurement cycle in days
        Y = Evaluation adjustment used by DCSC
        Z = Evaluation adjustment used by DGSC & DISC
        X = Ratio of evaluation adjustments = Y/Z

Then from the descriptions of the evaluation adjustments for DCSC and for DGSC & DISC given in Sections 3.6.1 and 3.6.2:

$$Y = R * E * P$$
$$Z = D * E$$

In order to compute the ratios between the two methods of determining evaluation adjustments, the expressions given above for Y and Z may be substituted in the expression for X:

$$X = Y / Z$$
$$= (R * E * P) / (D * E)$$
$$= (R * P) / D$$

The total contract price is equal to the procurement cycle times the average daily demand. Hence:

$$P = C * D$$
or $$D = P / C$$

Substituting for D in the last expression for X:

$$X = (R * P) / (P / C)$$
$$= (R * P * C) / P$$
$$= R * C$$

Using the latest estimates of the overall average Day Cost Ratios (shown in the report referenced in Section 1.1) and the median procurement cycle times (as of the second quarter of CY 94), the ratios between the two methods of determining evaluation adjustments may be computed for each supply center. The results are:

Table 3-10
Comparison of Methods of Determining Evaluation Adjustments

	DCSC	DESC	DGSC	DISC
Overall Average Day Cost Ratio = R	.00134	.00043	.00081	.00060
Median Procurement Cycle (days) = C	365	578	426	365
Ratio of Evaluation Adjustments (DCSC method / DGSC & DISC method)	0.49	0.25	0.35	0.22

The method of determining evaluation adjustments used by DCSC results in substantially smaller adjustments than does the method used by DGSC and DISC, ranging from 22 percent to 49 percent and averaging about 1/3 of the amounts using the DGSC and DISC method. Of course the evaluation incentives paid by DCSC are correspondingly smaller.

3.6.4   ADVANTAGES AND DISADVANTAGES

Both current methods are very easy to apply. However, each method has drawbacks that could result in protests, excessive or insufficient evaluation factor being applied and/or non-optimal awards. The main disadvantage of the DCSC method is that the Day Cost Ratio was developed as an average for an entire FSC or Center. Its use for a specific NSN could result in errors depending on how far from average the particular NSN behaves concerning costs associated with lead time changes. The DISC (and DGSC) method uses item dependent factors rather than averages. However, inventory control theory refutes the direct link between lead time reduction and inventory levels. The buffer effect of a variable safety level to prevent backorders results in an indirect effect. It can be shown mathematically that only the variable safety level quantity is affected by lead time changes and that the reorder quantity is set only by demand and procurement cycle time. Thus if PLT is reduced, there will only be a permanent reduction in

safety levels and overall inventory levels are reduced by the safety level reduction. Lower PLT can delay future awards, but the amount ordered can only be reduced by the safety level reduction associated with the PLT reduction of the prior buy. Since the DCSC factors are based solely on safety level effect, the theoretical underpinning of the method is sound. The other method is simple and seems to make sense, but in reality overstates the impact of the shorter PLT.

3.6.5   AN ALTERNATIVE APPROACH

In an effort to capture the strengths of each of the two existing methods, a third alternative method was developed. Like the DISC method it avoids average factors and uses item specific data. Like the DCSC method it is based on safety level changes as a basis for savings associated with PLT reductions. In fact, this approach assumes a linear relationship between PLT and variable safety level. Also, this approach recognizes the fact that PLT reductions may not be completely sustained in future buys, the "rebound" effect. In addition to being more complex, this approach requires some research during bid evaluation. The proposed DEF is shown below:

PROPOSED DEF

Definitions:

C_1 - The unit price of the low bid

C_2 - The unit price of the evaluated bid i.e. early delivery

ALT- Administrative Lead Time of record

PLT- Production Lead Time of record

DAYS - Difference in delivery days between evaluated bid and low bid

QTY - quantity of purchase

VSL - Variable Safety Level from Supply Control Study

k- constant to reflect inabilty to sustain PLT reduction (rebound effect)

Award to low bid if:

$$\frac{C_2}{C_1} > \frac{QTY+VSL}{\left(QTY+ \left[\frac{ALT+ PLT-(DAYS*k)}{ALT+PLT} \right]*VSL \right)}$$

Rationale:

This approach assumes VSL is directly proportional to PLT reductions. The SAMMS formula is complex but simulation models have shown that effect is nearly linear. If lead time is zero, VSL is zero; and if DAYS is zero, VSL is unchanged. This formula is derived from the concept that bids are equal if the unit price times the inventory affected are the same. If C_2 is greater than C_1, the total cost can still be less since it will be applied against a lower total quantity because the VSL is reduced. The value for the constant k could be set to activate when

DAYS exceeds some high number set by the Center reflecting higher likelihood of a rebound for extreme early deliveries. Data from DISC suggests that the value for k should be about 2/3.

4.1 <u>OVERVIEW</u>

Conclusions are divided into two groups. Section 4.2 addresses the five specific concerns listed in Section 1.1 of this report (as well as the Task Order and Study Plan). Section 4.3 provides other, more general conclusions.

4.2 <u>CONCERNS</u>

4.2.1 **CONCERN 1**

CONCERN: Since unplanned early deliveries do not immediately reduce safety stocks, the assumed benefits may not be realized.

CONCLUSION: This concern is valid. Deliveries on initial DEF buys normally are unplanned in the sense that the buys are triggered by PLTs longer than the actual PLTs. Thus, material is received before it is needed, even for safety stock. Unneeded early deliveries trigger early payments. Hence, from a cash flow standpoint, unneeded early deliveries from DEF buys are undesireable.

4.2.2 **CONCERN 2**

CONCERN: DEFs may need to be modified for very early deliveries because of diminishing marginal benefits.

CONCLUSION: This concern is partly valid. There is no supporting theoretical or empirical evidence that suggests diminishing marginal benefits from reduced lead times, provided that the system works as intended (i.e. that although evaluation incentives are used only to obtain initial early deliveries, the PLT reductions are sustained in subsequent buys). On the contrary, inventory theory indicates that safety stocks are almost directly proportional to lead times. Savings in the cost of maintaining safety stocks per day of reduced lead time do not vary with the size of the reduction. Thus, as lead times are reduced, cost savings increase correspondingly. Unfortunately, empirical evidence suggests that the system often does not work as intended. In particular, PLT reductions in DEF buys are not consistently sustained in subsequent nonDEF buys (see Concern 4).

4.2.3 **CONCERN 3**

CONCERN: Early deliveries expected in DEF procurements may not be achieved.

CONCLUSION: This concern is not valid. The analysis indicates that about 85 percent of the DEF buys were shipped on time. This is actually better than the on time rates for nonDEF buys.

4.2.4   CONCERN 4

CONCERN: Although expected PLT reductions may be achieved in initial deliveries, they may not be sustained in subsequent deliveries, thereby voiding the expected benefits.

CONCLUSION: This concern is valid. The analysis indicates that PLT reductions for DEF buys are not consistently sustained in subsequent nonDEF buys. Over the period of analysis, overall percentage declines in average PLTs were about the same regardless of whether any DEF buys had been used. This is especially disturbing, since (according to inventory control theory) payments of evaluation incentives are justified by the safety stock reductions made possible by projected future PLT reductions.

4.2.5   CONCERN 5

CONCERN: The various methods of calculating DEFs may not be equally appropriate.

CONCLUSION: This concern is valid. The method of calculating evaluation adjustments used by DCSC is similar to the method used by most supply centers for determining the cost of late deliveries. It is based upon well accepted inventory control theory which applies to changes in projected lead times, regardless of whether the changes are positive (longer PLTs) or negative (shorter PLTs). However, the factor used is a center average which may or may not reflect the costs associated with a specific NSN. The method used by DGSC and DISC appears to be arbitrary. It results in substantially higher evaluation incentives. Considering the danger associated with using an average factor in lieu of item specific data, the more conservative proposed method outlined in 3.6.5 is preferable.

4.3   GENERAL

4.3.1   SUSTAINED PLT REDUCTIONS

Although the percentage declines in average PLTs were about the same regardless of whether DEF buys were used, one cannot be certain that DEF buys do not result in PLT reductions in future nonDEF buys. During the period of analysis, PLTs declined across the board. This may be the result of using the DEF program, thereby making both buyers and contractors generally more cognizant of the importance of short PLTs.

4.3.2   UNIT PRICES

Although payments of evaluation incentives tangibly add to costs, the analysis does not show that DEF buys cause increases in average unit prices.

4.3.3   OVERALL EVALUATION

The overall effort to reduce PLTs is working. Because of the number of programs that can affect PLTs, that are going on simultaneously, it is difficult to separate the contributions of each program.

This study does not provide sufficient information for making overall judgements about the extent to which a DEF program should be used. The answer depends upon such intangibles as management style, buyer and contractor awareness of the value of consistently low PLTs, other programs to maintain low PLTs, etc. The best answer may depend upon considerations unique to a supply center, or even to a specific business unit within a supply center.

SECTION 5
RECOMMENDATIONS

Determination of when use of evaluation incentives is appropriate should be left to the discretion of supply center management. When their use is appropriate, evaluation adjustments should be determined in accordance with the proposed method developed in 3.6.5. Because of data limitations, it would be appropriate to reevaluate the use of DEF's when all centers have used the technique for a period of time, perhaps in one to two years.

REPORT DOCUMENTATION PAGE

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This study evaluated the use of Delivery Evaluation Factors (DEF) at the DLA hardware Centers. DEF clauses allow the buyer to factor earlier delivery schedules into the award process by costing the benefit of early delivery and reducing the bid price of a vendor who offers earlier delivery. Data from the Defense Industrial Supply Center (DISC) from Jan 92-Jun 94 was analyzed to determine the effect of the program. The other Centers had insufficient experience to evaluate historical data. The analysis showed that DEF buys were associated with large reductions in Production Lead Time and late deliveries and contributed to an overall reduction in PLT at DISC. Average unit prices were not found to be adversely affected by DEF. However, it was observed that the benefits of a DEF buy were not completely sustained in subsequent non-DEF buys. Because of this and the afct that each Center used a different mathematical formula to apply DEF, we recommended an alternative method which will reduce the amount of the factor.

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